4.0 SOURCE IDENTIFICATION

4.1 The Erosion Process

The principal source of pollutant export associated with construction activities is erosion. Soil erosion is the process by which the land's surface is worn away by the action of wind, water, ice, and gravity. Natural, or geologic erosion, has been occurring at a relatively slow rate since the earth was formed and is a tremendous factor in creating the earth as we know it today. Except for some cases of shoreline and stream channel erosion, natural erosion occurs at a very slow and uniform rate and is a vital factor in maintaining environmental balance.

4.1.1 Types of Erosion

Water-generated erosion is unquestionably the most severe type of erosion, particularly in areas of development. Consider the erosive action of water as the effects of the energy developed by rain as it falls, or as the energy derived from its motion as it runs off the land surface. The force of falling raindrops is applied vertically, and the force of flowing water is applied horizontally. Although the direction of the forces created is different, they both perform work in detaching and moving soil particles. Water-generated erosion can be classified into the following types:

- Raindrop erosion is the first effect of a rainstorm on the soil. Raindrop impact dislodges soil particles and splashes them into the air. These detached particles are then vulnerable to the next type of erosion.
- Sheet erosion is the erosion caused by the shallow flow of water as it runs off the land. These very shallow moving sheets of water are seldom the detaching agent, but the flow transports soil particles which are detached by raindrop impact and splash. The shallow surface flow rarely moves as a uniform sheet for more than a meter (3 feet) on land surfaces before concentrating in the surface irregularities.

- Rill erosion is the erosion which develops as the shallow surface flow begins to concentrate in the low spots of the irregular contours of the surface. As the flow changes from the shallow sheet flow in these low areas, the velocity and turbulence of flow increase. The energy of this concentrated flow is able to both detach and transport soil materials. This action begins to cut small channels of its own. Rills are small but well-defined channels which are normally less than 100 mm (4 inches) deep. The rills are easily obliterated by harrowing or other surface treatment.

- Gully erosion occurs as the flow in rills comes together in larger and larger channels. The major difference between gully and rill erosion is in magnitude. Gullies are too large to be repaired with conventional tillage equipment and usually require heavy equipment and special techniques for stabilization.

- Channel erosion occurs as the volume and velocity of flow causes movement of the streambed and bank materials.

4.1.2 Factors Influencing Erosion

The erosion potential of any area is determined by four principal factors: the characteristics of the soil, vegetative cover, topography, and climate. Although each of these factors is discussed separately herein, they are interrelated in determining erosion potential.

Soil characteristics which influence the potential for erosion by rainfall and runoff are those properties which affect the infiltration capacity of a soil and those which affect the resistance of the soil to detachment and being carried away by falling or flowing water. The following four factors are important in determining soil erodibility:

1. Soil texture (particle size and gradation).
2. Percentage of organic content.
3. Soil structure.
4. Soil permeability.

Soils containing high percentages of fine sands and silt are normally the most erodible. As the clay and organic matter content of these soils increases, the erodibility decreases. Clays act as a binder to soil particles, thus reducing erodibility. However, while clays have a tendency to resist erosion, once eroded, they are easily transported by water. Soils high in organic matter have a more stable structure which improves their permeability. Such soils resist raindrop detachment and infiltrate more rainwater. Clean, well-drained and well-graded gravel and gravel-sand mixtures are usually the least erodible soils. Soils with high infiltration rates and permeabilities either prevent or delay and reduce the amount of runoff.

Vegetative cover has an extremely important role in controlling erosion as it provides the following five benefits:

1. Shields the soil surface from raindrop impact.
2. Protects root systems by holding soil particles in place.
3. Maintains the soil's capacity to absorb water.
4. Slows the velocity of runoff.
5. Removes subsurface water between rainfalls through the process of evapotranspiration.

By limiting and staging the removal of existing vegetation and by decreasing the area and duration of exposure, soil erosion and sedimentation can be significantly reduced. Special consideration should be given to the maintenance of existing vegetative cover on areas of high erosion potential such as moderately to highly erodible soils, steep slopes, drainageways, and the banks of streams.

Topography. The size, shape, and slope characteristics of a watershed influence the amount and rate of runoff. As both slope length and gradient increase, the rate of runoff increases and the potential for erosion is magnified. Slope orientation can also be a factor in determining erosion potential. For example, a slope that faces south and contains droughty soils may have such poor growing conditions that vegetative cover will be difficult to re-establish.

Climate. The frequency, intensity, and duration of rainfall are fundamental factors in determining the amounts of runoff produced in a given area. As both the volume and velocity of runoff increase, the capacity of runoff to detach and transport soil particles also increases. Where storms are frequent, intense, or of long duration, erosion risks are increased. Seasonal changes in temperature, as well as variations in rainfall, help to define the high erosion risk period of the year. When precipitation falls as dry snow, no erosion will take place. However, when the temperature rises, melting snow adds to runoff, and erosion hazards are high. Because the ground may still be partially frozen, its absorptive capacity is reduced. Frozen soils are relatively erosion-resistant. However, soils with high moisture content are subject to uplift by freezing action and are usually very easily eroded upon thawing.

4.2 Sedimentation

Normally, runoff builds up rapidly to a peak and then diminishes. Excessive quantities of sediment are derived by erosion, principally during the higher flows. During lower flows, as the velocity of runoff decreases, the transported materials are deposited to be picked up by later peak flows. In this way, sediments are carried downslope, or downstream, intermittently and progressively from their source or point of origin.

4.2.1 Sediment Pollution and Damage

Sediment pollution is soil out of place. It is a product accentuated by the activities of man which leads to severe soil loss. When these large quantities of soil enter our waters, then sediment pollution occurs.

Over four billion tons of sediment are estimated to reach the ponds, rivers, and lakes of our country each year, and approximately one billion tons of this sediment are carried all the way to the ocean. Approximately 10 percent of this amount is contributed by erosion from land undergoing highway construction or land development. Although these latter quantities may appear to be small compared to the total, they could represent more than one-half of the sediment load carried by many streams draining small subwatersheds which are undergoing development.

Excessive quantities of sediment cause costly damage to waters and to private and public lands. Obstruction of stream channels and navigable rivers by masses of deposited sediment reduces their hydraulic capacity which, in turn, causes an increase in subsequent flood crests and a consequent increase in the frequency of damaging storm events.

Sediment may fill drainage channels, especially along highways and railroads, and plug culverts and storm drainage systems, thus necessitating frequent and costly maintenance. Municipal and industrial water supply reservoirs lose storage capacity, the usefulness of recreational impoundments is impaired or destroyed, navigable channels must be continually dredged, and the cost of filtering muddy water preparatory to domestic or industrial use may become excessive. The added expense of water purification in the United States, because of sedimentation, amounts to hundreds of millions of dollars each year.

In an aquatic environment, the general effect of fine-graded sediments such as clays, silts, and fine sands is to reduce drastically both the kinds and the amounts of organisms present. Sediments alter the existing aquatic environment by screening out sunlight and by changing the rate and the amount of heat radiation. Particles of silt settling on stream and lake bottoms form a blanket which creates a hostile environment for the organisms living there and literally smothers many of them and their eggs.

Coarser-grained materials also blanket bottom areas to suppress aquatic life found in these areas. Where currents are sufficiently strong to move the bedload, the abrasive action of these materials in motion accelerates channel scour and has an even more severely deleterious effect upon aquatic life. The aesthetic attraction of many streams, lakes, and reservoirs used for swimming, boating, fishing, and other water-related recreational activities has been seriously impaired or destroyed by bank cutting and channel scour, accelerated by a higher flood stage induced by sedimentation.

4.2.2 Costs

Many state and local jurisdictional agencies require that land-disturbing activities have an approved E&S control plan prior to commencement of work. The owner is responsible for the development of E&S control plans. Once a plan is approved, generally a contractor will be responsible for implementing, installing, and maintaining the E&S control plan. However, the owner is ultimately responsible and in many instances must certify that the plan will be carried out. Once the project has moved through the bid process, the cost of implementation becomes the primary concern. Proper implementation of the E&S plan can save the developer and the contractor money in excavation costs. If denuded areas are stabilized initially, little or no additional work will be required later. This can speed up completion dates, and overall savings will be realized. This strategy requires that planning take on a more important role in the management of a project. Good management throughout the life of a project will lead to increased savings.

On the other hand, failure to implement an E&S plan or failure to maintain controls during construction of a project can mean additional costs to the developer and the contractor. These additional costs exist at three levels. The primary level is the cost of work being stopped for noncompliance with an approved plan; the secondary level is the cost of repairing damage to adjacent properties; the tertiary level would be the costs associated with missed deadlines, litigation with damaged parties, and extra charges by the contractor for additional work. The perception by the public that the developer and the contractor were negligent in performing their responsibilities may also pose a negative cost, if not immediately, sometime in the future.

4.3 Other Potential Nonsediment Pollutants

The general permit requires the listing of potential nonsediment pollutants likely to be present in storm water in significant quantities. The sections below discuss potential pollutants which are commonly associated with construction activities.

4.3.1 Nutrients

Nitrogen, phosphorus, and potassium are the major plant nutrients used for the fertilizing of new landscape at construction sites. Heavy use of fertilizers can result in the discharge of nutrients to water bodies resulting in excessive algal growth and eutrophication, and in some states a violation of water quality standards.

4.3.2 Trace Metals

Galvanized metal, painted surfaces, and pressure-treated lumber comprise many of the surfaces exposed to storm water as a result of construction activity. These coatings and treatments contain metals which enter storm water as the surfaces corrode, flake, dissolve, decay, or leach. Acid rain can accelerate these processes.

4.3.3 Pesticides

Herbicides, insecticides, and rodenticides are commonly used at construction sites. The unnecessary or improper application of these pesticides may result in direct contamination, indirect pollution through drift, or the transport of soil surfaces into water.

4.3.4 Spills and Illegal Dumping of Construction Materials

Petroleum products, pesticides, and other synthetic organic compounds (glues, sealants, solvents, etc.) are used widely at construction sites and may be improperly stored and disposed. Deliberate dumping of these materials, which can migrate into surface or groundwater resources, is a direct violation of the CWA. On parking lot or highway construction projects, the application of diesel fuel to the contact surfaces of the "hot mix asphalt" application and transport vehicles is a common practice that should be discontinued immediately.

4.3.5 Miscellaneous Wastes

Miscellaneous wastes include wash from concrete mixers; solid wastes resulting from the clearing and grubbing of vegetation; wood and paper materials derived from packaging of building products; food containers such as paper, aluminum, and steel beverage cans; and sanitary wastes. In addition to erosion and sediment controls, the SWPPP must address the other potential pollutant sources that may exist on a construction site. These controls include proper disposal of construction site waste; compliance with applicable state or local waste disposal, sanitary sewer, or septic system regulations; control of offsite vehicle tracking; and control of allowable nonstorm water discharges which are discussed in Section 6.5.

4.4 Allowable Nonstorm Water Discharges

The following discharges are generally allowed if they do not commingle with contaminated material or other discharges associated with industrial activity:

- Uncontaminated flows from fire fighting.
- Fire hydrant flushing.
- Potable water sources including water line flushing.
- Uncontaminated groundwater resulting from dewatering activities.
- Uncontaminated flows from foundation or footing drains.
- Naturally occurring flows such as springs, wetlands, and riparian habitats.

- Irrigation water discharged during seeding, planting, and maintenance, provided fertilizers and pesticides are applied correctly.
- Pavement wash waters for dust control and general housekeeping practices providing that spills or leaks of toxic or hazardous materials have not occurred and where detergents are not used.

It must be emphasized that the flows described above are uncontaminated flows. For example, if the discharge from potable water line flushing were to collect significant amounts of sediment or contaminants while flowing over soil or pavement, it would be considered contaminated and, therefore, could not be discharged directly to the storm drain system.

4.5 Pollutant Lists

The construction activity should list any pollutants that have a reasonable potential to be present in the storm water discharge in significant quantities. The definition of significant quantities varies from item to item. In general, a significant quantity is taken to be any quantity that is not consumed within a normal day's operations or would result in spills beyond the immediate cleanup capabilities of the individual charged with the use of the materials. A significant quantity also relates to a "reportable" quantity for those substances that are regulated under SARA Title III Section 313, or any of the programs mentioned in Section 2.6. Table E-1 in Appendix E has been provided to inventory materials found onsite.

Some of the primary contaminants associated with construction activities are as follows:

- CCA treated lumber
- AZCA treated lumber
- Boiler treatment chemicals
- Creosote
- Tribucide
- Diesel fuel
- Fire retardant
- White wood
- Fuel oil
- Detergents
- Gasoline
- Hydrogen peroxide
- Maintenance and motor lubricants and coolants
- Paints, thinners, and sealants
- Pentachlorophenol treated lumber
- Metal studs
- Propane
- Solvents
- Sulfuric acid
- Timbor
- Mold inhibitor
- Water repellant
- Refrigerant
- Concrete
- Tar

- Fertilizers
- Hydraulic fluid
- Masonry block
- Roofing shingles

4.6 Significant Spills or Leaks

Because construction activities may handle certain hazardous substances over the course of the project, spills of these substances in amounts that equal or exceed Reportable Quantity (RQ) levels are a possibility. EPA has issued regulations that define the reportable quantities for oil and hazardous substances. These regulations are found at 40 CFR Part 110, 40 CFR Part 117, and 40 CFR Part 302. If a release occurs, a contingency plan should be put into effect. The single most important action required in the contingency plan should be to minimize environmental impacts or health threats. If there is a RQ release during the construction period, the following actions must be taken:

- Notify the National Response Center immediately at (800) 424-8802; in Washington, DC, call (202) 426-2675.
- Within 14 days, submit a written description of the release to the EPA Regional office providing the date and circumstances of the release and the steps to be taken to prevent another release.
- Modify the SWPPP to include the information listed above.

If a spill occurs and the above actions are taken, the single most important action is to document all calls, correspondence, and any other communications relative to the spill. Record names, titles, phone numbers, dates, times, and any other information that may be used to prove that the actions were taken.

The construction activity must list all historical spills or leaks of toxic or hazardous pollutants to the storm water system that have occurred in the last 3 years. This list must include: toxic chemicals listed in 40 CFR Part 372 that have been discharged to storm water as reported on EPA Form R, and oil or hazardous substances in excess of reportable quantities, 40 CFR

Part 110, 117, or 302. Table E-2, in Appendix E may be used to record the lists described previously.

The SWPPP should designate a person who is accountable for spill response at the construction site. The designated person will be responsible for emergency procedure action and documentation. The responsible person should be thoroughly trained and familiar with all aspects of the response plan as well as the operations and daily activities of the construction activity. In addition this person must have the authority to commit the resources needed to accomplish the spill plan response.

Contingency plans are required by law for proper response to a hazardous waste, chemical, or oil spill. The plans are designated Exhibit E-1, -2, and -3, in Appendix E. These plans are provided as a guideline only and should be customized by the construction activity. These plans and lists of contacts should be posted in obvious locations to facilitate a quick response to any spill.

The key to a successful SWPPP is that no matter what quantities of materials are dispensed and stored, proper and safe management can reduce the risk of spills and leaks substantially. The following sections highlight the most common activities with a reasonable potential for spill or releases of hazardous materials to ground or surface water resources.

4.6.1 Bulk Chemical and Fuel Storage or Transfer Areas

Underground fuel storage has been addressed in other EPA programs. The use of double containment tanks, monitoring wells, and other controls has been established and all facilities should be in compliance. (The construction activity management should assure itself that all regulated underground storage tanks meet requirements.) Not all tanks fall under existing programs. The objective is to assure that tank contents do not leak into the storm sewer system or into the groundwater.

Aboveground storage tanks are not regulated in the same way that underground tanks are regulated. Areas containing fuel, lubricants, chemicals, waste oil, waste solvent, and other such tanks or storage barrels should be covered (preferably under roof) wherever possible. Storm water flows should be directed around the storage locations. Protective dikes around the sites which can provide containment are also in order, particularly if the potential spill volume exceeds the sump volume or what can be contained using absorbent "pillows" or other material and containment booms.

The construction activity should identify areas in which a leak or a spill of significant materials could result in contact with storm water runoff and enter the storm water drainage system. These areas will coincide with areas of material handling, transfer, and storage. After areas of concern are identified, specific material handling procedures, storage requirements, and cleanup equipment and procedures should be established. Table E-4, in Appendix E, will be used to record the spill control and countermeasures established by the construction activity. Additional documentation relating to spill prevention countermeasures and control must be added to the SWPPP document.

Aboveground tanks are primarily used for the bulk storage of chemicals, diesel, gasoline, coolants, and lubricants. These tanks may be serviced by any combination of below ground or aboveground piping systems. Bulk shipments are generally received from tank trucks. The products are off-loaded adjacent to the storage tanks and are dispensed to equipment as needed. Hazardous wastes generated from construction activity operations primarily consist of contaminated sediments from the fueling or maintenance areas.

Waste oils are stored in both aboveground and underground tanks. Generally, the tanks are less than 1,900 liters (500 gallons) in capacity. All outdoor, aboveground tanks should be contained by dikes having adequate volume to hold a spill and, depending upon the region, an appropriate precipitation event. Underground storage tanks (UST's) must conform to their own set of regulations. The SWPPP should contain appropriate references to UST management.

Outdoor storage of chemicals, including petroleum substances, is a major environmental concern at construction sites. Aboveground tanks are subject to solar heating resulting in potential explosive gases near vents, collisions from moving equipment, acts of vandalism, acts of disgruntled employees, etc. UST's may be a source of leaks. Storm water discharges have a potential of being contaminated during excavation, backfilling, maintenance, and remediation activities involving fuel storage tanks. Construction activities may have outdoor collection tanks for waste oil. These tanks may leak or overflow if they are not properly maintained.

4.6.2 Vehicle and Equipment Fueling Areas

Fuel is usually delivered to construction activities by tank truck. The bulk storage area should be contained by dikes and loading/unloading areas should be served by oil/water separators. Dispensing to vehicles and equipment is usually accomplished through standard fuel dispensers. Most spills are relatively minor. Spills are usually cleaned up by construction activity personnel and/or private contractors under the supervision of the local fire department. In the event a spill does reach the storm sewer system, a licensed cleanup contractor should be immediately dispatched to clean out the storm lines and recover spilled fuel.

4.6.3 Vehicle and Equipment Maintenance Areas

Most construction activity vehicles and equipment are maintained by construction activity personnel and are frequently repaired and serviced on the jobsite. Substantial volumes of petroleum oils, including engine oil, transmission fluid, brake fluid, and other lubricants, are used in vehicle maintenance operations. As a result, there is a potential for illicit discharges or storm water discharge contamination by oils, solvent, lubricants, fuel, and coolants.

Equipment maintenance typically takes place in one of two locations: (1) the construction activity maintenance area or garage; or (2) wherever the equipment breaks down. The potential for storm water contamination where the equipment is serviced must be considered.

The following fluids have the potential to enter the storm water system from spillage: diesel fuel, gasoline, engine oil, hydraulic fluid, transmission fluid, lubricants, refrigerants, and solvents. All spillage other than potable water should be prevented from entering the storm water system. Engine oil and hydraulic fluids are used in relatively small quantities but may enter the storm drain system during precipitation events. If the garage area has unsealed cracks, spillage may result in groundwater contamination. Maintenance activities which occur inside garages may result in storm water contamination through floor drains connected to the storm sewer system. Hydrocarbon spillage should be minimized and cleaned up when it occurs. Residual cleanup waters should be passed through an oil/water separator into a sanitary sewer system if available or transported to a permitted treatment facility.

4.6.4 Vehicle and Equipment Cleaning Areas

The spent wash water from vehicle and equipment cleaning may be contaminated with surface dirt, rust, flash metal, or paint from the surface of the equipment and fluids (fuel, hydraulic fluid, oil, lubricants, etc.). Most construction activity vehicles and equipment are maintained by construction activity personnel and are frequently repaired and serviced on the jobsite. As a result, there is a potential for illicit discharges or storm water discharge contamination by oils, solvents, lubricants, fuel, and coolants.

EPA regulations prohibit the discharge of wash water from car and truck cleaning facilities without a permit. The potential for storm water runoff contamination and the presence of illicit discharges from these facilities must be considered. The discharge should be treated for the removal of oil, grease, solvents, soaps, and solids prior to discharge to receiving waters. Although some vehicle-cleaning activities are not currently covered separately by the EPA storm water regulations, these activities must be addressed under the SWPPP wherever storm water may come into contact with the results of activities that are covered.

4.6.5 Combined Sewer Overflow (CSO)

Many of our nation's older and more-established cities are coping with problems related to a deteriorated infrastructure stressed beyond capacity. Chronic flooding occurs in some areas where storm sewer trunk lines were not designed to convey the extent of development that has occurred. As a result of this flooding, deteriorated sanitary sewers are overloaded by infiltration and inflow (I & I). This I & I laden sewage often overflows during high intensity or long duration storms washing pollutants into surface waters. Several older cities combined sanitary and storm sewers into a single combined sewer system, These also overflow during larger storm events as combined sewer overflows. These discharges containing raw sewage threaten the health of all who come into contact with them. In addition to being a threat to public health, CSO's jeopardize the beneficial use of surface waters. High bacterial counts result in beach closings and shellfish contamination. Low dissolved oxygen levels affect the health of fish and other aquatic life. Toxic pollutants tend to settle out and increase the level of contamination in the sediments. Floating debris, containing materials commonly associated with sewage, is offensive and greatly reduces the enjoyment of streams, rivers, and coastal zones.

Federal and state regulatory agencies are currently struggling to develop the proper program for monitoring and controlling CSO's. They are struggling because each system varies from one community to the next, and each CSO solution is inherently complex and potentially expensive. Programs are in place to attempt to control I & I problems with sanitary sewer systems. The required level of control for the CSO discharges is not clearly specified in current NPDES discharge permits, nor are CSO control requirements defined in most state water quality standards. Construction designers and managers should be aware of the state and local trends concerning CSO's. Impacts concerning problems could conceivably result in sanitary sewer user fees, moratoriums on expansion, or even requiring onsite sewage disposal.

4.6.6 Onsite Sewage Disposal Systems

Onsite sewage disposal systems (OSDS) include conventional septic systems, large-scale conventional systems, alternative and innovative designs, and private sewage treatment facilities. The term applies to any residential or industrial sewage that is not treated or planned for treatment in a centralized public sewer system.

Proper treatment of wastewater effluent with onsite disposal systems is an essential component of surface water quality protection. When properly sited, designed, permitted by state or local health authority, installed, and maintained, individual sewage disposal systems can be used to treat most pollutants found in construction activity wastewater simply and effectively. Treated wastewater usually reaches surface waters by ground water recharge or by ground/surface water interfaces.

4.7 Summary of Sampling Data/Existing Water Quality

If storm water runoff from the proposed construction site has been sampled and analyzed for the presence of any pollutant (e.g., total suspended solids), then the results of the analyses must be included in the SWPPP. In most cases, existing runoff water quality data are not available for a specific site, particularly an undeveloped site. However, if the construction is on or adjacent to an existing industrial facility, that facility may have collected runoff water quality data to satisfy another permit. If there are no existing data on the quality of runoff from the site, then it is not necessary to collect samples for the general permit. Runoff water quality data may sometimes be available from your state or local government. You may also be able to obtain runoff water quality information from the USGS or state or local watershed protection agencies. The sampling event(s) information should be recorded in Table E-3, in Appendix E, and a one-page summary included from the sampling data report package. Previous sampling data will be useful in determining the source of pollutants and in initiating controls.